8th NOAA TBPG Workshop
Kansas City, MO
April 25-26, 2017

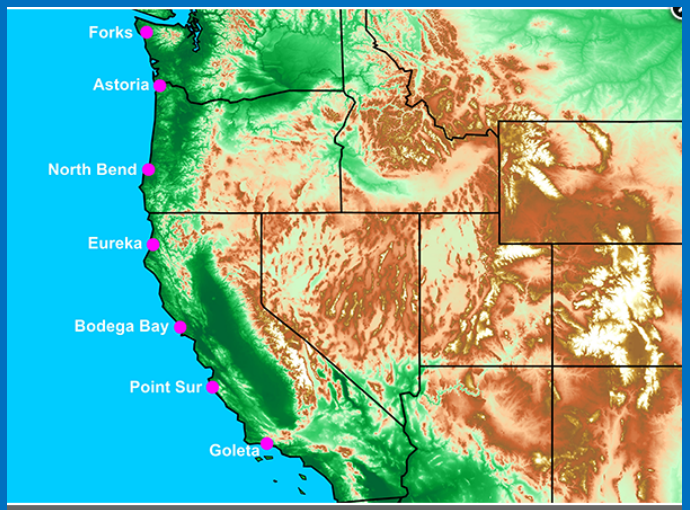
Roundup Presentation

Hydrometeorology Testbed (HMT)

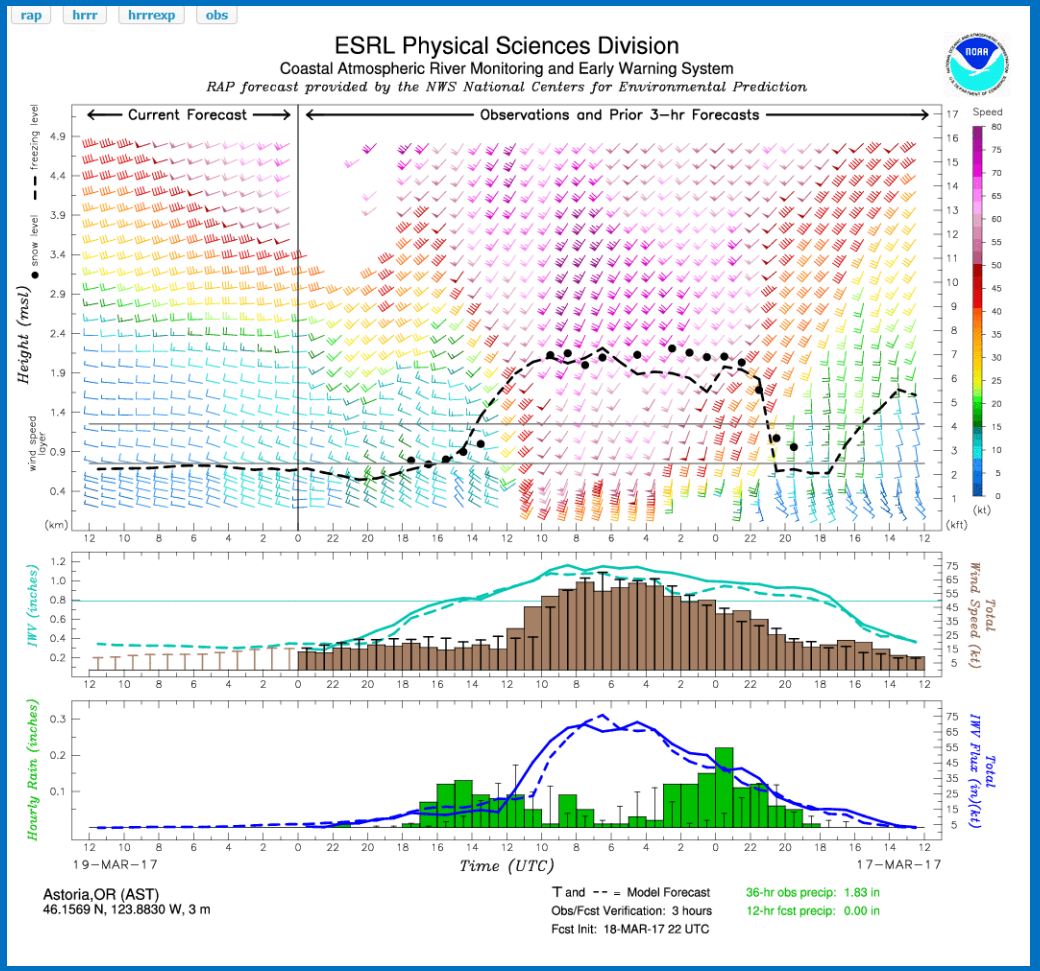
James Nelson (NWS/WPC), Lisa Darby (OAR/PSD),
Allen White (OAR/PSD), and David Novak (NWS/WPC)

HMT Highlights

"Picket fence" of atmospheric river observatories complete

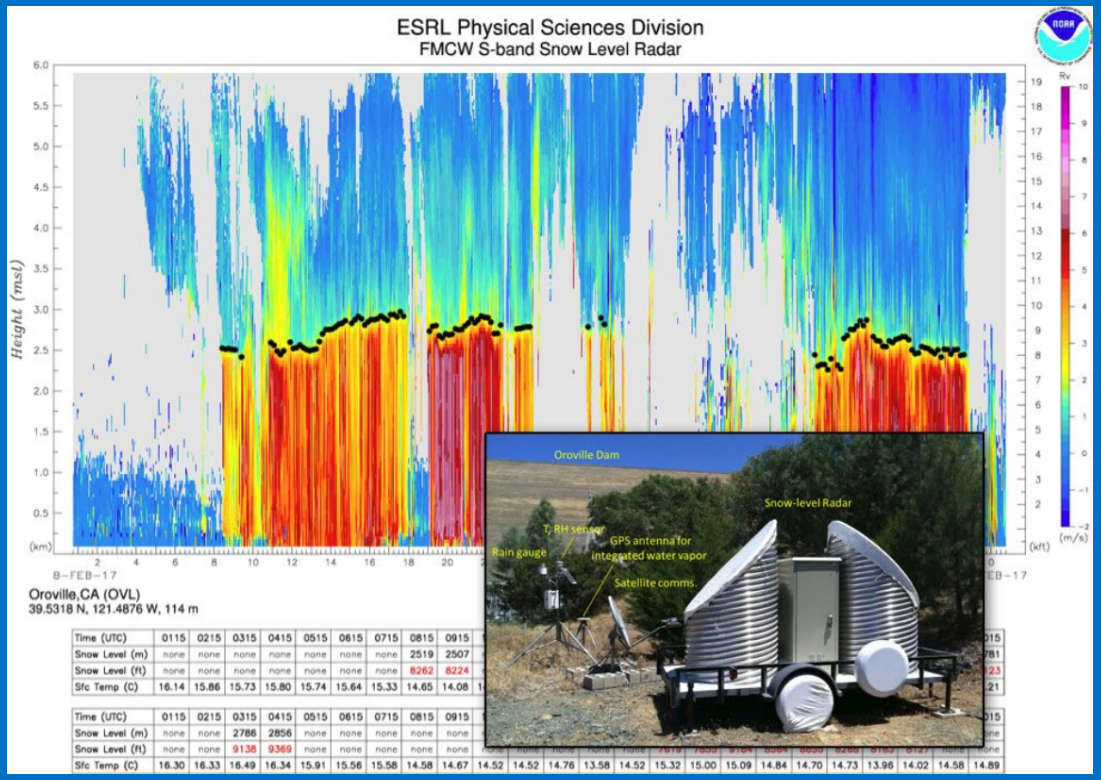


Basemap of the U.S. West Coast showing seven-station 'picket fence' of ¼-scale 449-MHz wind profilers assembled, deployed, operated and maintained by PSD engineers. (Credit: NOAA)



HMT Highlights

- FMCW s-band Snow level radar at Oroville Dam (photo by Clark King) featured in NOAA Story Map
- A cost-effective, snow-level radar developed by **NOAA's Earth System Research Laboratory** measures where falling snow changes to rain above the dam. This distinction is critical. Rain falling on snow or bare ground increases immediate flood threats, while snow falling in the watershed stays in place until it melts.



Demonstration of Advanced Ensemble Prediction Services for NWS Hydrometeorological Forecast Operations

Kelly Mahoney (NOAA/PSD) and Dave Gochis (NCAR)

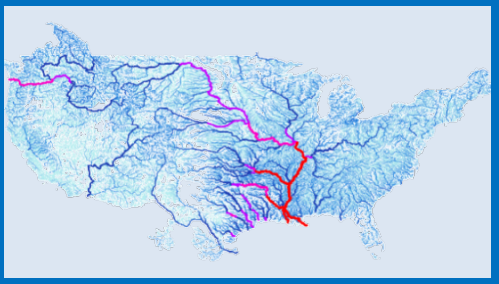
- 2017 objectives:
  - Create hydrometeorological time-lagged ensemble
    - Consecutive HRRR members drive National Water Model
  - Develop experimental forecast guidance: enhance flash flood prediction via combined hydrometeorological forecasts
  - Forecaster testing and evaluation: probabilistic time-lagged hydro ensemble capabilities & new NWM hydrologic outputs
- 2017 R2O highlights
  - Close collaboration with National Water Center → new probabilistic flash flood and river flood guidance products based on early HMT project prototypes and 2016 forecaster feedback, survey results
  - Producing real-time experimental products (deterministic and probabilistic) for testing in 2017 FFaIR at HMT@WPC

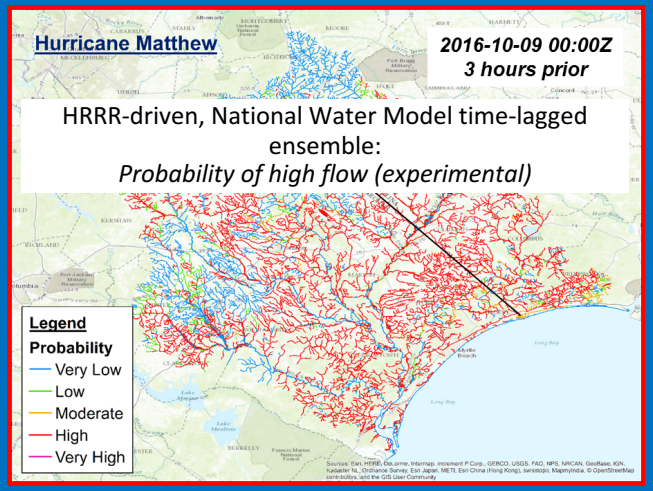
Multi-agency team:

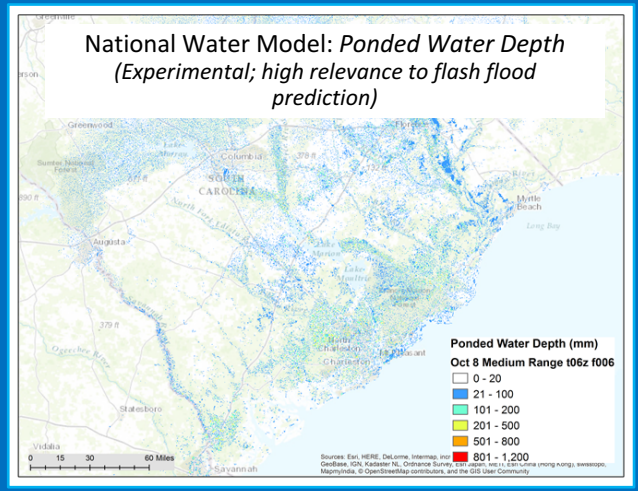
- Kelly Mahoney (NOAA/PSD)
- Dave Gochis (NCAR)
- Fernando Salas (OWP/NWC)
- Brian Cosgrove (OWP/NWC)
- Trevor Alcott (NOAA/GSD)
- Rob Cifelli (NOAA/PSD/OWP)
- James McCreight (NCAR)
- Daniel Nietfeld (NOAA/NWS/WFO Omaha)
- Chad Kahler (NOAA/NWS/WRH)
- Dave Reynolds (NOAA/ESRL/PSD, CIRES)
- Stan Benjamin (NOAA/GSD)
- Mark Strudley (NOAA/NWS/WFO Monterey)

National Water Model

Initial Operating Capability – v1.0 implemented in Aug. 2016







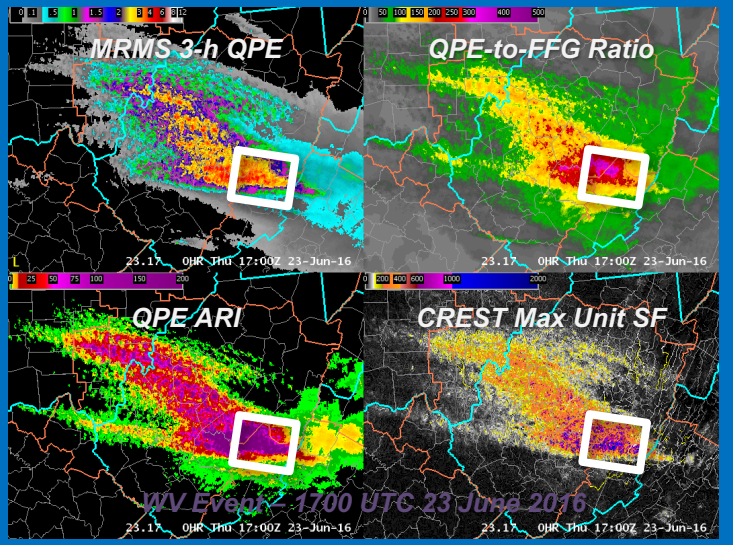
2016 HMT Multi-Radar Multi-Sensor (MRMS) Hydro Experiment:

Jonathan J. Gourley (CIMMS)

- **GOAL:** Explore utility of experimental products comprising MRMS that force flash flooding in the FLASH system.
- Hosted 16 forecasters over three weeks from 20 June to 15 July
- Experiment Goals Overview:
  - –Evaluate short-term flash flood prediction tools (e.g., FLASH)
  - –Assess use of 0–6 h HRRR QPF in warning decision making process
  - –Evaluate watches/warnings and use of minor/major flash flood probabilities
  - –Enhance cross-testbed collaboration with FFaIR Experiment
  - –Identify best practices for transition of FLASH to NWS operations

2016 HMT Multi-Radar Multi-Sensor (MRMS) Hydro Experiment:

Jonathan J. Gourley (CIMMS)



- Feedback on FLASH product suite for flash flood warning decision making and identifying potentially significant flash flood events
- Overall increase in flash flood warning (FFW) lead time
  - –Five FFWs saw lead time increase by > 40 minutes
- MRMS QPE and CREST model output generally ranked highest when compared to spatial coverage, magnitude of flash flood events
- Collaboration with FFaIR benefitted flash flood situational awareness and experimental watch issuance

Storm-Scale Ensemble Prediction Optimized for Heavy Precipitation Forecasting

PIs: Drs. Ming Xue, Fanyou Kong, and Keith Brewster (OU/CAPS)

- ***Goal:*** *Improve CAPS storm-scale ensemble forecast (SSEF) of QPF using advanced data assimilation (EnKF) and 3DVAR cloud analysis techniques*
- ***Accomplishments:***
  - ***Ensemble QPF product development***
    - *Met with WPC scientists on current ensemble tools and needs for additional ensemble products and plan logistics of transfer of forecast and product files.*
    - *Completed software development for new ensemble products as decided in coordination calls and meeting with WPC*
    - *Complete testing of QPF products to be used in 2016 FFaIR.*
    - *Complete implementation of file transfer logistics for forecast and product files to HMT @ WPC.*
    - *CAPS scientist Keith Brewster participated in FFaIR experiment, and also gave a seminar*

Storm-Scale Ensemble Prediction Optimized for Heavy Precipitation Forecasting

PIs: Drs. Ming Xue, Fanyou Kong, and Keith Brewster (OU/CAPS)

New Products for 2017

- Localized Probability Matched (LPM) mean QPF (with an efficient algorithm and demonstrated improved skill) – need development and evaluation;
- Percentile ensemble QPF , such as 90%, 95% (or other percentile values demonstrated with improved skills than ensemble max and/or PM mean)
- Possible phase-alignment ensemble mean and comparison with PM mean
- Neighborhood probability, etc

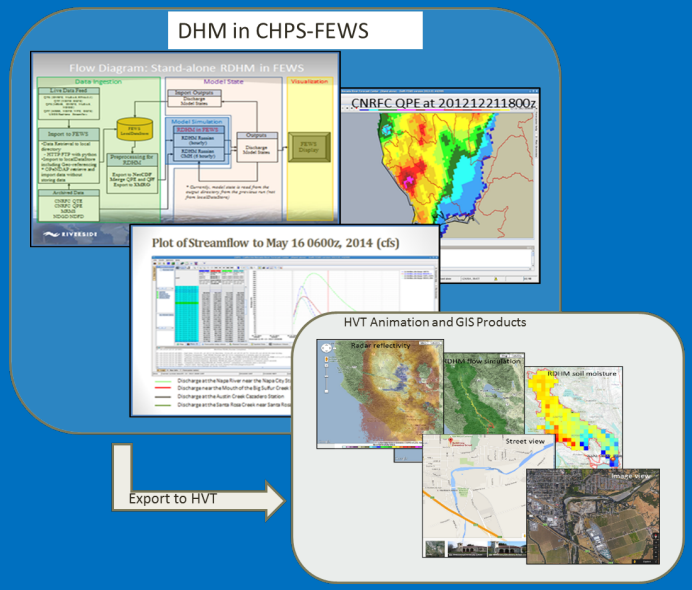
Transition to Operations

- Based on FFaIR evaluations, select optimized deterministic and probabilistic QPF forecast products and recommend for operational use;
- Together with the CLUE project at HWT, recommend optimal CAM ensemble configurations for first-generation operational HREF (High-Resolution Ensemble Forecasting)

Distributed Hydrological Modeling for NWS Flash Flood Operations

Lynn Johnson (CSU/CIRA, ESRL/PSD), James Halgren (Riverside Technology, Inc.), and Tim Coleman (CU, formerly ESRL/PSD)

Goal: Assess whether and how a DHM approach can provide enhanced hydrologic services.



Highlights:

Advisory Panel meetings

- Webinar conducted to review project progress
- PIs currently incorporating AP feedback into project

Prototype

- DHM/CHPS/FEWS maintained by Riverside
- Inconsistencies found in precipitation data sets – currently being evaluated
- Currently operationalizing QPF/QPE workflows and export of additional data for the HVT

Interface

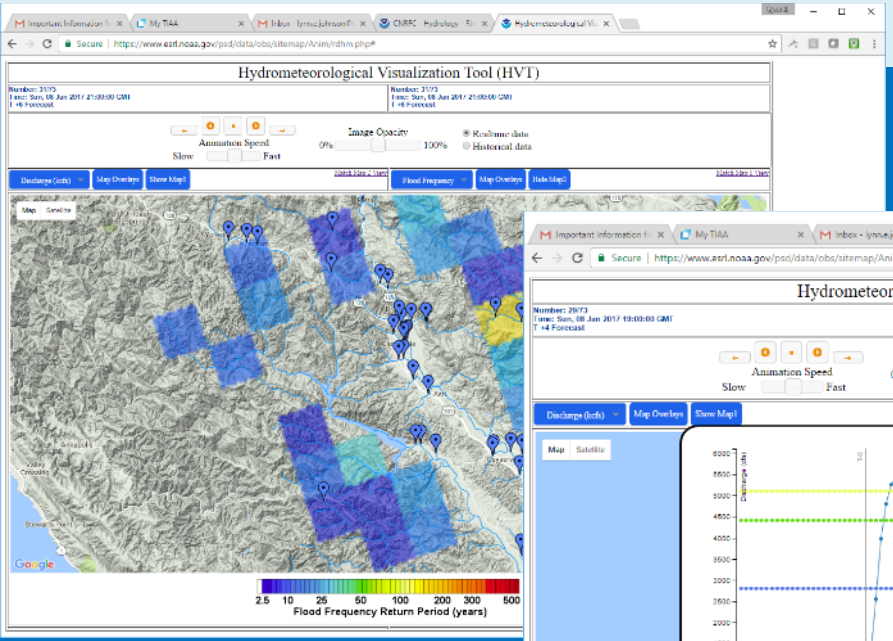
- Hydromet Visualization Tool (HVT) developed using Google Maps interface
- HVT remained stable and operational during the 2016-2017 winter storm season
- Archived storm event data will be made available for retrospective assessments

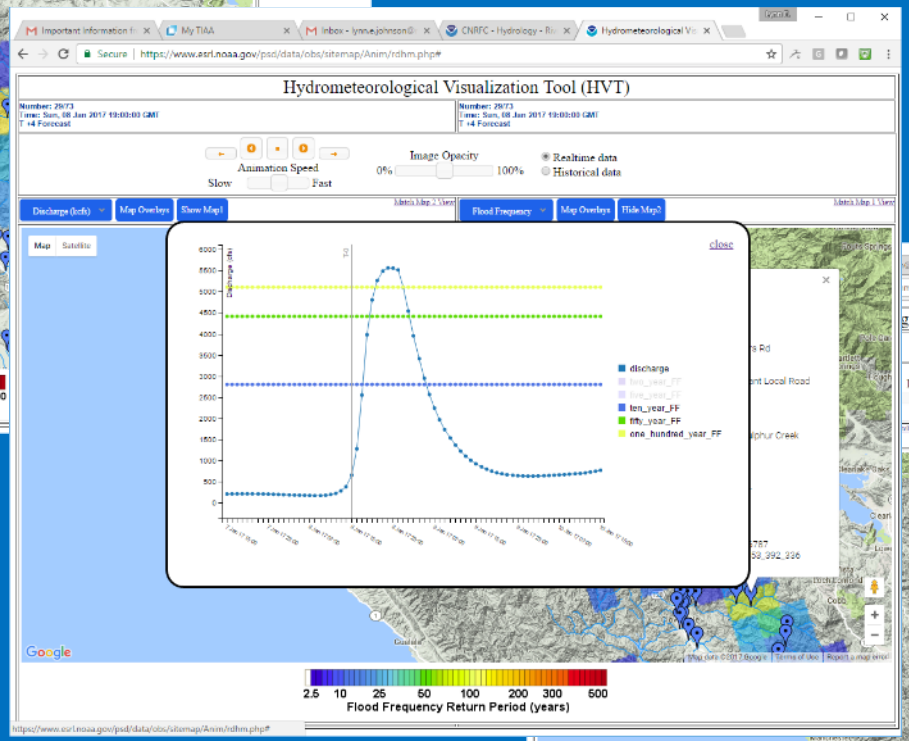
Assessment and Evaluation

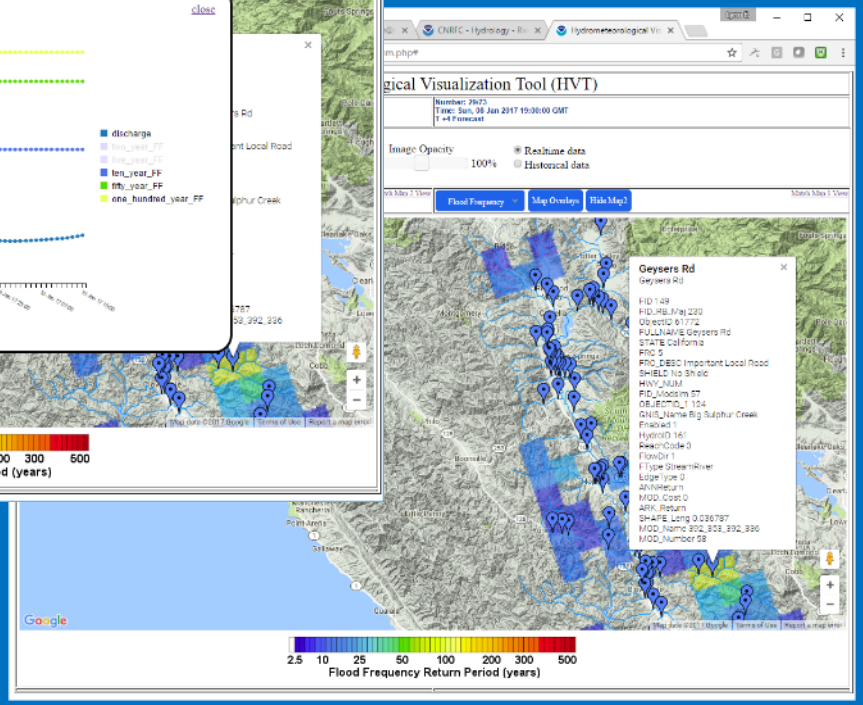
- Five user groups identified
- Assessment plan will be finalized
- Will conduct retrospective reviews of significant fllod events with the AP

Distributed Hydrological Modeling for NWS Flash Flood Operations

Lynn Johnson (CSU/CIRA, ESRL/PSD), James Halgren (Riverside Technology, Inc.), and Tim Coleman (CU, formerly ESRL/PSD)







RUSSIAN RIVER BASIN
EVENT JANUARY 4-9, 2017
Big Sulfur Creek – Geysers Road

Hydromet Visualization Tool (HVT)

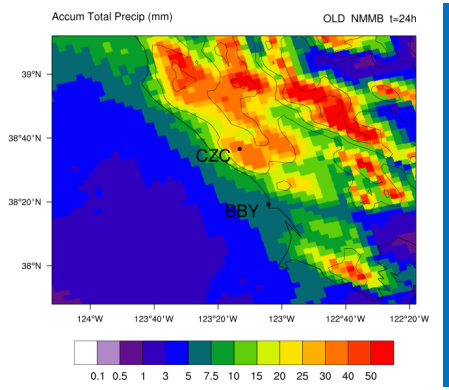
Time series
Hydrographs
Hyetographs
Grids of:
Precipitation
Surface runoff
Soil moisture
Threshold frequency
Impact features
Road crossings
Critical facilities

Validation and Improvement of Microphysical Parameterizations for Better Orographic Precipitation Forecasts

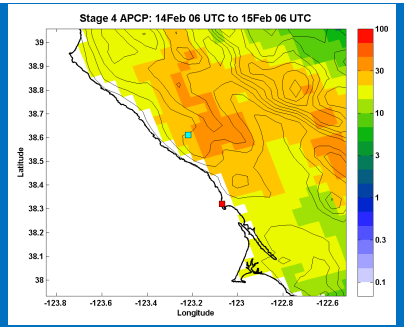
PI's: David Kingsmill and Jian-Wen Bao

- **Goals:** Run retrospective simulations of a western U.S. storm using the NMMB with various operational microphysics schemes...validating the results with high-quality HMT observations.
- Use results to change Ferrier-Aligo scheme to improve orographic precip.
- GRAPHICS: NMMB simulation of a landfalling storm impacting the HMT-West coastal domain 14-16 Feb 2011.
- The original Ferrier-Aligo (F-A) microphysics scheme was employed in this simulation.

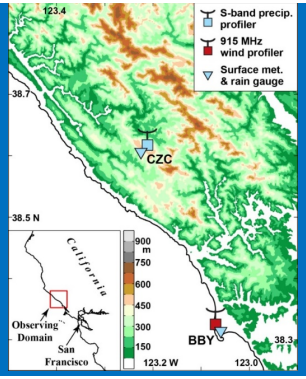
NMMB 24h QPF Ending at 06 UTC 15 Feb 2011



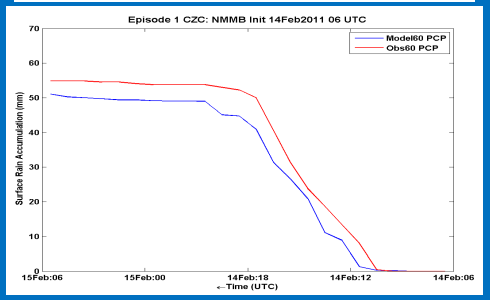
Stage 4 24h QPE Ending at 06 UTC 15 Feb 2011



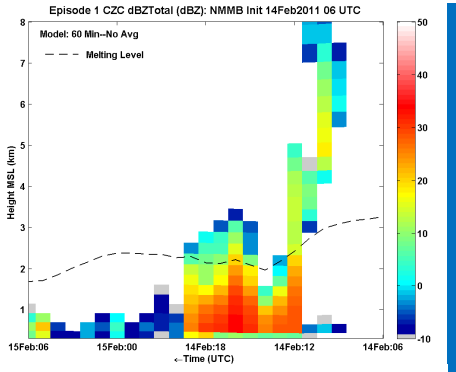
HMT-West Coastal Domain



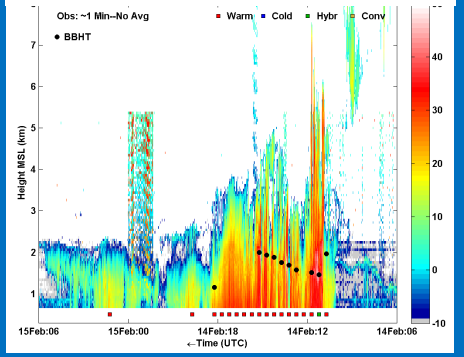
Observed and Simulated Precipitation at Cazadero (CZC)



Simulated Reflectivity over CZC



Observed Reflectivity over CZC



FY16 Highlights

WPC-HMT – 2016 FFaIR Experiment

- 2016 Flash Flood and Intense Rainfall Experiment

FY16 Highlights

WPC-HMT – 2016 FFaIR Experiment

- 2016 FFaIR Goals
  - Evaluate ways to maximize the utility of high resolution convection-allowing models and ensembles for short-term flash flood forecasts.
  - Identify the most effective forms and proper usage of available hydrologic guidance for the assessment of flash flood risk.
  - Explore proposed changes to WPC's operational Excessive Rainfall Outlook by evaluating the guidance for and utility of probabilistic flash flood forecasts for Day 1 and Day 2 respectively.
  - Enhance cross-testbed collaboration as well as collaboration between the operational forecasting, research, and academic communities on the forecast challenges associated with short-term flash flood forecasting.

FY16 Highlights

WPC-HMT – 2016 FFaIR Experiment

- 2016 FFaIR Results
  - Use of the high-resolution convective-allowing NAMRR out 60 hours statistically improved the Day 2 experimental Excessive Rainfall Outlook (ERO). More CAMs are desired for longer-range forecasting.
  - Experimental soil saturation fields have value for assessing flood risk especially when coupled with QPF. Of highest value for short-term flash flooding prediction is the top 1 cm of soil saturation. Forecast patterns of soil reaction and flooding need to be investigated further.
  - Average Return Intervals (ARIs) are beneficial for flood risk situational awareness, however, more valuable are high-resolution convective-allowing ensemble probabilities of QPF exceeding ARIs.
  - National Water Model streamflow anomalies provide basic situational awareness for flood risk but do not indicate tangible flood potential.
  - Runoff fields from models derived from QPF and land surface are not scientifically reliable for the assessment of flash flooding but a similar field is desired by forecasters and should be explored further.

FY16 Transition Metrics

WPC-HMT 2016 FFaIR Experiment

Major Tests Conducted	Transitioned to Operations (RL9)	Recommended for Transition to Operations (RL9)	Advanced To Experimental Testing (RL8)	Further Demonstration/ Development (RL 5-7)	Rejected For Further Testing
Runoff fields from the NAMv4, HRRRv3; Runoff probabilities from HRRR-TLE				X	
QPF Probability-Matched Mean from SSEFX, HREFX		X			
GOES-R proxy total rainfall QPE product				X	
NAMv4 utility at longer time ranges for improvement of Day 2 ERO	X				
Soil Saturation fields from the National Water Model, NAMv4, HRRRv3		X			
Extreme Precipitation Forecasting Table (EPFT) showing ARI/QPF ratios	X				
High-res CAM ensemble probabilities of QPF exceeding FFG/ARI/thresholds	X	X			

FY17 Highlights

WPC-HMT – 2017 Winter Weather Experiment

- 2017 WWE Goals
  - Explore the Experimental HRRR and HRRR-TLE for winter weather forecasting, including 1- hour snowfall accumulation.
  - Evaluate neighborhood versus grid spacing probabilities for forecasting hourly snowfall amounts.
  - Evaluate the parallel 3 km NAMv4 for 1-hour snowfall rate forecasts.
  - Explore the utility of joint probability tools for winter weather impacts-based forecasting.
  - Examine the utility of the WPC Watch Collaborator trend tools.
  - Evaluate the utility of a model implicit PWPF methodology.
  - Test the utility of issuing both experimental, impacts-based winter weather alerts as well as traditional winter weather watches from a national center perspective.
  - Enhance collaboration among NCEP centers, WFOs, and NOAA research labs on winter weather forecast challenges.

FY17 Highlights

WPC-HMT – 2017 Winter Weather Experiment

- 2017 WWE Results
  - The hourly snowfall accumulation fields from the NAMv4 and HRRRv3 were determined to be beneficial to the forecast process
  - probabilistic hourly snowfall fields from the HRRR-TLE provided valuable information when forecasting snowfall and snow intensity.
  - WPC Implicit PWPF showed significant potential compared to the operational PWPF in the 2017 WWE particularly with increasing terrain detail and spatial distribution of the snowfall over the CONUS.
  - Watch Collaborator Trend Tools were useful for establishing forecast trends and tailoring Winter Storm Watch considerations.
  - The concept of joint probabilistic guidance was of great interest and value to participants for a quick assessment for the potential of multiple hazards. The WPC joint probabilities were a first attempt at providing the guidance.
  - Winter Storm Watches and Winter Weather Alerts from a national center perspective were successfully tested for the first time, as encouraged by the FY17 AFS Milestone.

FY17 Transition Metrics

WPC-HMT 2017 Winter Weather Experiment

Major Tests Conducted	Transitioned to Operations (RL9)	Recommended for Transition to Operations (RL9)	Advanced To Experimental Testing (RL8)	Further Demonstration/ Development (RL 5-7)	Rejected For Further Testing
WPC Experimental Implicit PWPF			X		
WPC Watch Collaborator Tools		X			
NAMv4 1-Hour Max Hourly Frozen Precipitation Rate		X			
NAMv4/HRRRv3 Hourly Snowfall Accumulation Guidance		X			
HRRR-TLE Probabilistic Snowfall Rate Guidance		X			
WPC Joint Probabilities			X		
Experimental Winter Storm Watches by National Center			X		

- Backup

2016 HMT Multi-Radar Multi-Sensor (MRMS) Hydro Experiment:

Jonathan J. Gourley (CIMMS)

- Four papers, either directly or indirectly related to the HMT-Hydro experiment, were published in the February 2017 issue of BAMS
  - Argyle, E. M., J. J. Gourley, Z. L. Flamig, T. Hansen, and K. Manross, 2017: Towards a user-centered design of a weather forecasting decision support tool, *Bull. Amer. Meteor. Soc.*, **98,** 373–382. *http://dx.doi.org/10.1175/BAMS-D-16-0031.1*
  - Martinaitis, S. M., J. J. Gourley, Z. L. Flamig, E. M. Argyle, R. A. Clark, A. Arthur, B. R. Smith, J. M. Erlingis, S. Perfater, B. Albright, 2017: The HMT Multi-Radar Multi-Sensor Hydro Experiment, *Bull. Amer. Meteor. Soc.*, **98,** 347–359. *http://dx.doi.org/10.1175/BAMS-D-15-00283.1*
  - Terti, G., I. Ruin, S. Anquetin, and J. Gourley, 2017: A situation-based analysis of flash flood fatalities in the United States, *Bull. Amer. Meteor. Soc.*, **98,** 333–345. *http://dx.doi.org/10.1175/BAMS-D-15-00276.1*
  - Gourley, J.J., Z. Flamig, H. Vergara, P. Kirstetter, R. Clark III, E. Argyle, A. Arthur, S. Martinaitis, G. Terti, J. Erlingis, Y. Hong, and K. Howard, 2017: The Flooded Locations And Simulated Hydrographs (FLASH) project: improving the tools for flash flood monitoring and prediction across the United States, *Bull. Amer. Meteor. Soc.*, **98,** 361-372. *http://dx.doi.org/10.1175/BAMS-D-15-00247.1*